How to Achieve High Load Factor Operation of Your Pulverized Coal Fired Power Plant

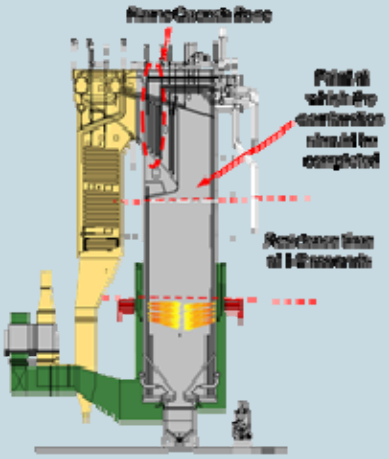
Storm Technologies, Inc. June 22, 2010

Getting the Inputs Right: Here are Some Tips to Consider

11 Reasons. Combustion optimization is done to…

1. decrease furnace NO_X production
2. decrease upper furnace slagging
3. decrease lower furnace slagging
4. decrease flyash unburned carbon content
5. decrease stack carbon monoxide levels
6. fire lower cost, lower quality fuels
7. improve boiler efficiency and unit heat rate
8. increase unit capacity
9. maintain or improve high reliability
10. improve electrostatic precipitator performance, which is adversely impacted by high carbon in ash
11. reduce SCR catalyst plugging

This month the focus is on reasons 8 and 9: operation at high capacity with maximum reliability.



A large utility boiler furnace only provides 1-2 seconds of residence time for complete combustion of carbon char. Use it wisely!

Coal Quality

Coal quality factors can become quite complicated, especially when minor elemental constituents that "poison" SCR catalyst are considered, such as arsenic. So, let's keep it light and general, just for a quick review of

- **Furnace Exit Gas** - The furnace exit gas must be oxidizing. Whether at 1% excess oxygen or 3% excess oxygen is best can be determined by a specific boiler comprehensive test. One important factor is to be certain combustion is completed below the

common coal quality factors that impact high load factor generation:

- **Ash Fusion Temperatures**– should be measured in a reducing atmosphere. The ash softening temperature of a fuel fired should be 100-150°F below the flue gas peak temperatures entering closer spacing than 6" centers of superheater or reheater pendants. Please note Figure 1.

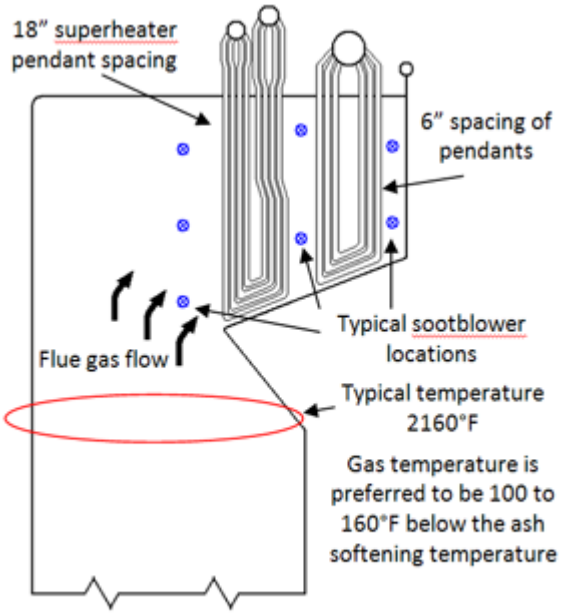


Figure 1

- **Iron content of the Ash**– for eastern fuels, this is a common problem with slagging at the superheaters and reheaters. This is principally because high iron content ash, say over 10% elemental iron in the ash, greatly lowers the softening and fluid temperatures of coal ash in a "reducing" atmosphere.

- **Furnace Excess Oxygen**– must be kept above about 2% at all points as measured by a water-cooled HVT superheater. A good guide to verify this is to measure the CO content through water-cooled HVT probes, with a gas sample conditioner and ECOM J2KN flue gas analyzer. Complete combustion in the burner belt should result in CO levels of less than 500ppm at the upper furnace. Remember, CO can continue burning in the convection pass and just because the stack CO is say, 50ppm, does not insure that combustion is optimum at all points in the furnace exit!

Figure 2

- **Representative Flyash Sampling** of a coal fired boiler should be done periodically. The best practical method of sampling flyash is to use a Storm in-situ flyash sampler as shown in Figures 3 and 4.

probe if a high iron ash is fired.

- **Fuel of Lower Volatile Matter –** When tuning a boiler, changes in the fuel such as a change in nitrogen content or lower volatile matter can create low furnace exit gas oxygen levels that can lead to lanes, or pockets, of reducing atmosphere. This of course can lead to slag accumulations due to ash chemistry factors. The changes can be compounded when an ash chemistry constituent, such as iron, increases.

The point of fuel quality is: small changes in fuel or ash chemistry can make large changes in boiler NOX, slagging or flyash unburned carbon content. Common coal quality factors that directly or indirectly impact boiler slagging includes:

- Ash softening and fluid temperatures in a reducing atmosphere
- Fuel HGI (Hardgrove Grindability Index)
- Ash iron content
- Fuel volatile matter

Lower HGI fuel can influence slagging because of the reduced coal fineness. This contributes to poor fuel balance, which in turn creates lanes of a reducing atmosphere. Lower fuel volatile matter will naturally produce more NO_X, so when burner or OFA adjustments are made to keep NO_X at the lower levels, increased secondary combustion can result in temperature and gas analysis extremes at the superheater.

What are some tips to maximum reliability and capacity?

- **Pulverizer Performance** - Keep pulverizer performance at the "peak." The best way to know the pulverizers

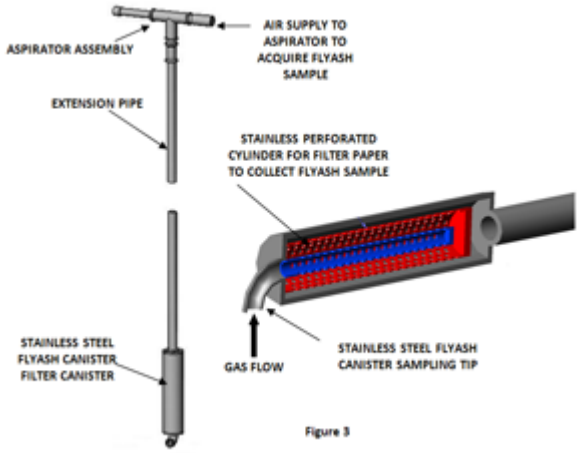


Figure 3

- **Oxygen Rise Tests – Furnace to Stack.** These should be run periodically to monitor boiler air in-leakage, air heater leakage and duct air in-leakage. These problems can sometimes be corrected online, if not, they can be added to the outstanding maintenance list and corrected at the first scheduled (or unscheduled) outage. The preferred excess oxygen levels are as shown in Figure 5.

- **Optimizing SCR Performance – "Popcorn Ash" -** Do you want to know where the ash cinders that are say about ¼" to 1" come from? Try observing the economizer inlet gas zone of the convection pass as the long retractable sootblowers are cycled.

are at peak performance is to test them frequently. All fuel lines should be sampled and all fuel samples should be sieved separately, preferably using four sieves (50, 100, 150, and 200 mesh). Ideally, 0% on 50 mesh and 75% plus passing 200 mesh will be achieved. Pulverizer adjustments to roll spring pressures, classifiers and primary airflow should be based on accurate fuel line testing. We continue to use and recommend the Storm isokinetic coal sampling method.

- **Raw Coal Sizing** should be ¾" top size. The coal should be run through a crusher at the power plant. Not only is the raw coal top sizing important for pulverizer and burner performance, but also for removal of tramp metal, rags, wood, etc. at the crusher. This minimizes pulverizer downtime from such foreign matter.

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Watch the "fireworks," "fireflies," or hot cinders cascade down through the convection pass. How do you reduce the number of cinders? **Apply the 13 Essentials and get the furnace inputs right!**

Is your SCR plugging with cinders? If so, you are not alone. Next come increased velocities through the remaining catalyst and possible ammonia slip. With the increased NH3 comes ammonium bisulfate deposition in the airheater(s). This is not the kind of situation that improves production during peak generation in July and August!

Testing and Tuning Yields Results!

Getting to the root cause of a slagging or high carbon in ash problem takes hands-on testing and techniques, effort and experienced test personnel. Storm Technologies, Inc. provides the best field-testing equipment and an experienced staff of test personnel. We also design fan boosted overfire air systems and special purpose combustion systems.

Using our resources to supplement yours is a cost-effective approach to utilizing assets. We take great pride in achieving **RESULTS**! We wish you a very productive summer of high load factor and low heat rate production!

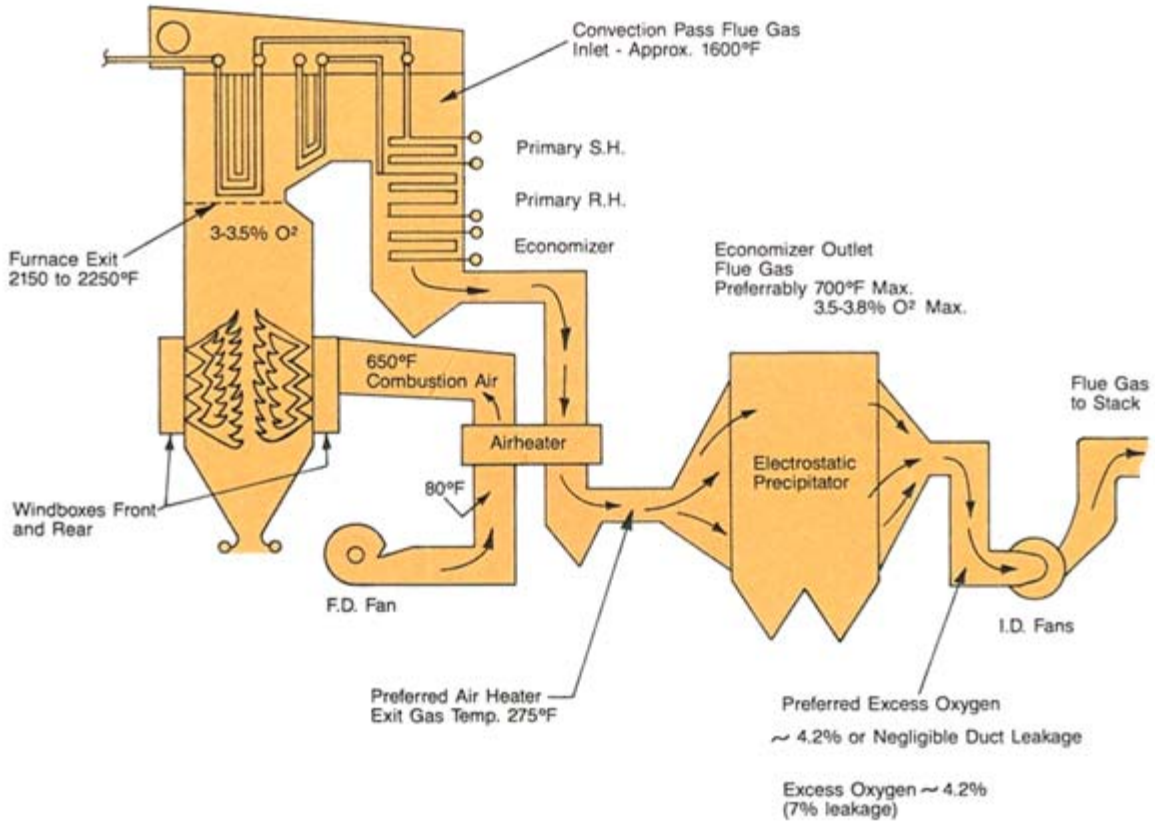

Figure 5

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